Transportation Synthesis Report

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Determining Depth of Utilities in Design Stages

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Wisconsin Highway Research Program
Technical Oversight Committee on Geotechnics

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Transportation Synthesis Reports are brief summaries of currently available information on topics of interest to WisDOT technical staff. Online and print sources for TSRs include NCHRP and other TRB programs, AASHTO, the research and practices of other transportation agencies, and related academic and industry research. Internet hyperlinks in TSRs are active at the time of publication, but changes on the host server can make them obsolete.

Request for Report

The Wisconsin Highway Research Program's Technical Oversight Committee on Geotechnics requested a synthesis report on current research and state transportation agency practices related to determining utility depths during design stages in order to accurately plan current and proposed utility locations.

Summary

This topic appears to be garnering increasing attention in national and state transportation agencies. At this time most practice employs a combination of technologies for locating utilities precisely under ground (in x, y, and z axes).

The use of global information systems (GIS), ground penetrating radar (GPR), and vacuum excavation technologies, which essentially drill for utilities with high-pressure air or water augmented by debris-clearing vacuum machinery, seem to be favored approaches. The FHWA several years ago mounted a campaign called Subsurface Utility Engineering, which focuses on such geophysics-based methods for precisely locating existing utilities. The SUE Web site features useful information. Another strategy entails fully integrating utility databases to provide detailed documentation of where utilities should be, based on data from utility companies and road builders.

The following documents and links focus strictly on location of utilities using non-destructive strategies; any of which could conceivably be used during the design stages of projects.

Current Research and Practice

The following entries represent state-of-the-art approaches to early identification of utility locations.

FHWA – Subsurface Utility Engineering (SUE). http://www.fhwa.dot.gov/programadmin/sueindex.htm. SUE employs various geophysical technologies to determine precise subsurface locations of utilities. This web site includes links, publications, and descriptions of approaches and options. Publications of particular value include:

- *Construction and Maintenance Fact Sheets – Subsurface Utility Engineering: Enhancing Construction Activities, May 2001*. http://www.fhwa.dot.gov/construction/fs01011.htm. This brief report notes that Virginia DOT began using SUE on all projects since 1984, and agencies in Arizona, Delaware, Florida, Georgia, Maryland, North Carolina, and Texas all use the method.
- *Purdue University Study, 1999*. http://www.fhwa.dot.gov/programadmin/PUScont.html. This study details various state transportation agency practices with SUE.
- *Reducing Utility-Related Delays: A Resource Guide*, *Focus*, July 2003. This details FHWA SUE efforts.

***Ignition* Magazine, Issue 8, Winter 2005.** http://trb.org/publications/ignition/ignition_8.pdf. Something called "mobile geophysical equipment" from a California technology firm can gather surface data that can be analyzed with software to create 3-D maps of areas for locating utilities. See "What Lies Beneath," p. 6.

Florida. SUE in Practice. Two articles in a surveying industry publication focus on the use of GPS, GPR and vacuum technologies by firms working with the Florida Department of Transportation on highway projects.

- Using GPR and GPS to locate utilities and following with vacuum excavation work that drills small potholes with a combination of high-pressure water or air and vacuums, one firm employs a technique it models on the FHWA subsurface utility engineering (SUE) model. See http://www.pobonline.com/CDA/Archives/7ea8771d9f0f6010VgnVCM100000f932a8c0____ .
- A different firm follows a similar process, turning also to a vacuum-excavation device after locating a utility site. See http://www.pobonline.com/CDA/Archives/d319771d9f0f6010VgnVCM100000f932a8c0____.

Los Angeles, Calif. Utility Location Data Integration.
http://directionsmag.com/article.php?article_id=597&trv=1. By combining GIS methods with use of a city database called NavigateLA – http://navigatela.lacity.org – contractors can access data on utility location. The city web site allows access to databases linking utilities information from various sources. Contractors now turn to this web site for interactive, annotated maps that can be updated in seconds, making it easier to coordinate public and private projects.

TRB Annual Meeting 2006. GPR in Pavement and Utility Work.
http://trb.org/am/ip/assembly_detail.asp?id=5543&e=68. This summary describes a slate of topics and speakers who addressed the use of GPR in pavement and utility work, sessions with included numerous presentations on finding utilities with GPR and other technologies and methods.

NCHRP Project 25-22. Technologies to Improve Consideration of Environmental Concerns in Transportation Decisions. Chapter 4: Remote Sensing Technologies. http://trb.org/publications/nchrp/cd-14/. Six technologies for remotely sensing objects are discussed, but only GPR is identified as being useful in locating subsurface utilities.

NCHRP Synthesis Report 255: Ground Penetrating Radar for Evaluation Subsurface Conditions for Transportation Facilities. See abstract at http://trb.org/news/blurb_detail.asp?id=3302. The focus of this 1998 study was on use of GPR in characterizing subsurface soil conditions and use in various pavement system analyses and environmental assessments.

Research in Progress

A variety of research is under way on the use of various technologies for locating precisely the underground depths of utilities.

New York. Applications of Ground Penetrating Radar for Highway Pavements. Aug. 2005-May 2006.
http://rip.trb.org/browse/dproject.asp?n=11314. GPR applications include pavement characterization and underground utilities data gathering. Research will produce an implementation strategy and work plan for use of GPR in highway evaluation.

Louisiana. Utility Locating Technologies. http://www.nal.usda.gov/ttic/utilfnl.htm#nondest. This study, which currently is soliciting recommendations, seeks to identify all the potential utility locating technologies available. It includes a thorough list of technologies and descriptions of each.

NCHRP 20-58(1). Detailed Planning for Research on Accelerating the Renewal of America's Highways, F-SHRP Web Document 1. http://trb.org/publications/f-shrp/f-shrp_webdoc_1.pdf. This report details a variety of tactics for accelerating highway construction. Amongst them is rapid identification of utility locations. See Project 1-1.1. Utilities Location Technology Advancements, 44-46, which details a 5-year study identifying and developing technologies for utility location.

Problem Statements 2005 – TRB Utilities Committee (AFB70), Design and Construction Group, Design Section. http://gulliver.trb.org/publications/dva/rps2005/AFB70-RPS05.pdf. The two problem statements of relevance are "Best Practice for Identifying Existing Underground Facilities Beyond Present Day Technology," and "'See Ahead' Technologies for Directional Drilling."